Space Weather Technical Forecast

Issued on Monday, 06 June 2022 at 01:24 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Active Electron Fluence. Chance of G1-G2/Minor to Moderate Storm intervals late 06 June from two possible CME arrivals.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low, with one long period C1.7 flare observed peaking at 05/1225UTC from the vicinity of AR3029 (Axx/Alpha) and was associated with a filament eruption. Although this has been modelled, it is not expected to be Earth-directed. There are a further four weak sunspot regions on the disc, all of these with limited evolution in the last 24 hours. No Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, has been at ambient levels. Density started around average, but has been slightly above average since 05/1000UTC, peaking at 05/1533UTC, which could be due to a glancing CME. Interplanetary magnetic field strength was weak, but with a slight increase from 05/1000UTC, which again could be a weak CME signal. The north south component, Bz, varied weakly, but with an increased amplitude, between +/-6nT since 05/1000UTC. Phi angle has been negative (towards the Sun) throughout. Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at background levels. Electron flux varied between moderate and high levels, reaching a peak of 4210 pfu at 05/1535UTC. Electron fluence has been above the Active (1e8 integrated pfu) threshold, but with a declining trend, falling to 1.92e8 integrated pfu by 05/2400UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is expected to be Low to Very Low, with only a very slight chance of Moderate activity.

Solar Wind / Geomagnetic Activity: Two CMEs which left the Sun on 01 and 02 June may glance the Earth early on 06 June, with limited evidence that they may have already affected the Earth's magnetic field. A third CME from 04 June may affect the Earth on 07 or 08 June, but again with low confidence in the forecast. No coronal hole high speed streams are expected to connect in the forecast period, with ambient solar winds dominating. Geomagnetic activity is forecast to be predominately Quiet, but increasing to Unsettled to Active should any CME arrivals occur. These will also give a chance of isolated G1-G2 Minor to Moderate storms, especially on 06 June.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10 MeV) is expected to be at background levels during this period. High energy electron flux (greater than 2MeV) is expected to vary between moderate to high values through the next four days, but with a declining high peak. Sharper declines will occur should the forecast CMEs significantly affect the Earth's magnetic field. Electron fluence is expected to decline below the Active (1e8 integrated pfu) through the next four days.

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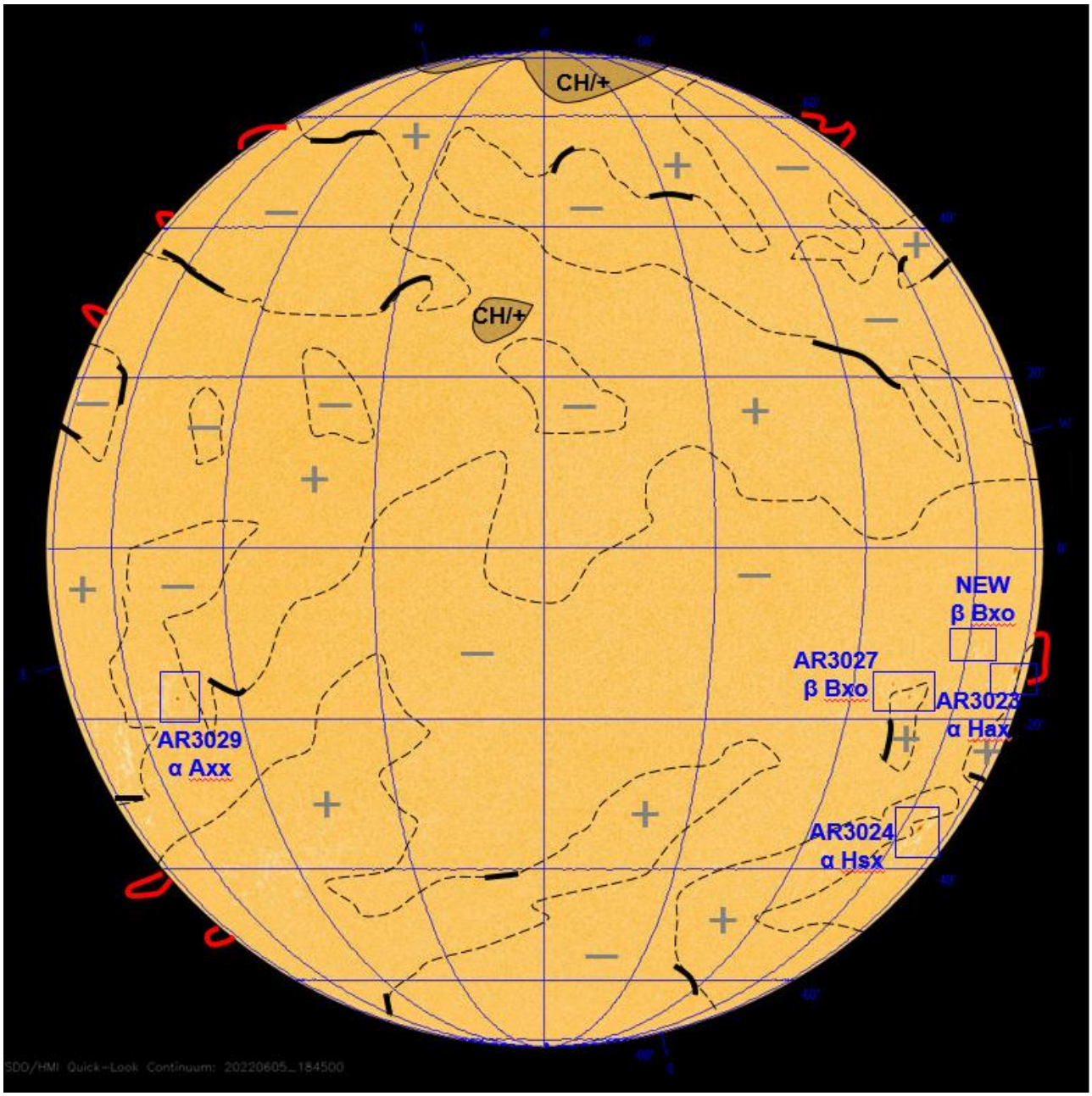
Figure 1. Solar Analysis Valid 05/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A filament was observed lifting off from centre disc on 01 June, with modelling suggesting a slight chance of a glancing blow early on 06 June. A further filament eruption from the southwest quadrant, may also glance the Earth on 06 June. There is a possibility that both features may combine given their relative speeds. A slight increase in density and total magnetic field strength late on 05 June may have been indicative of the glancing blow, but current observations are inconclusive. A further third CME, which left the Sun on 04 June from the northeast quadrant, is expected to miss the Earth, with low confidence that it may glance the Earth.

No coronal hole high speed streams are forecast to connect through the period, with solar wind speeds expected to remain at mainly background levels.

Geomagnetic activity is forecast to be mainly Quiet throughout the period. There is a risk of Active or G1-G2 Minor/Moderate storm intervals dependent on the possible CME arrival on 06 June. A further risk of enhanced geomagnetic activity is possible on 07 or 08 June due to a possible glancing CME.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	5	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
01/1300	Partial	Filament	04N 10W	252 km/s	15/1800 +/-12 hours	Limited shock
02/1315	Partial	Filament	06S 45W	525 km/s	06/0000 +/-12 hours	Glancing impact possible
04/1032	Partial	Filament	32N 30E	620 km/s	Possibly 07 or 08 June	Glancing impact possible

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Figure 2: L1/DSCOVR observations for last 24 hours. Possible weak CME effects are highlighted.

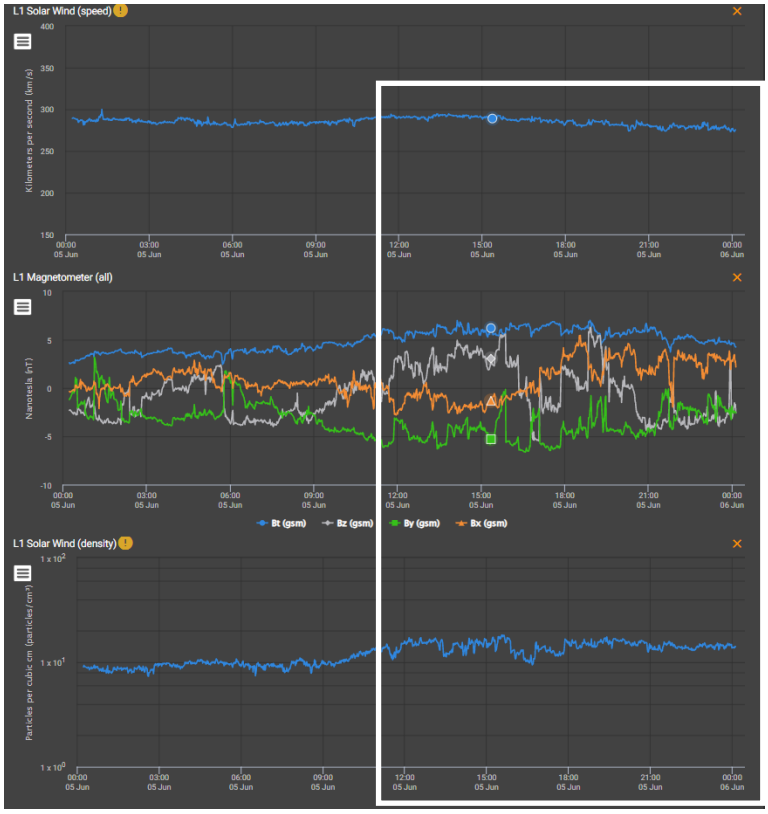

Figure 3: MOSWOC Enlil forecast showing potential timing of CME arrivals on 05 or 06 June

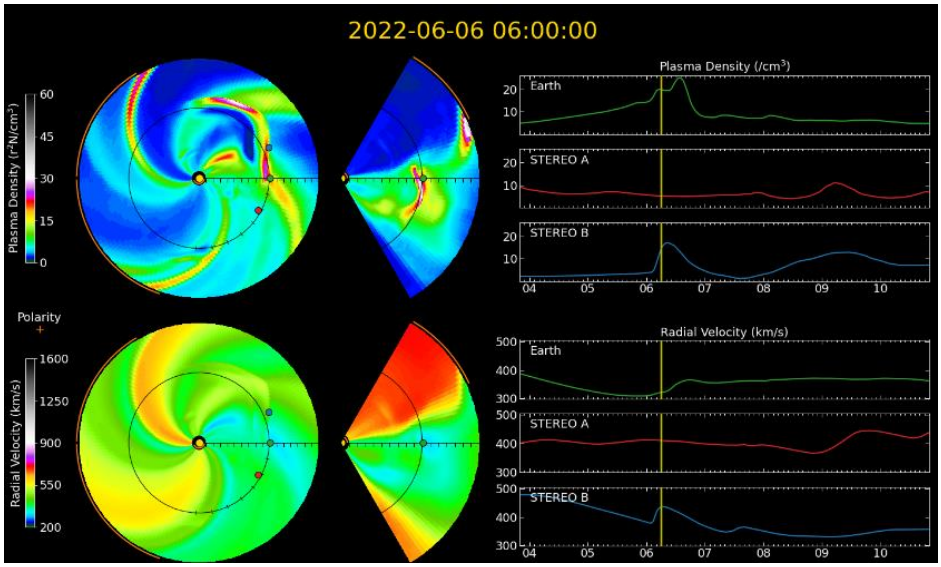

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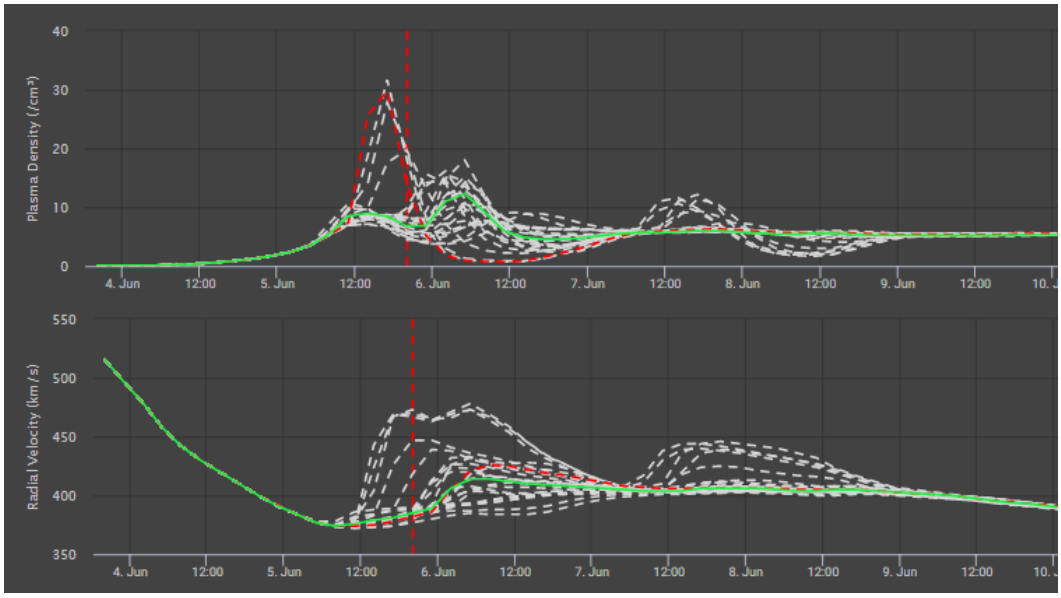
Figure 4: MOSWOC Enlil Ensemble model, showing potential range in arrival times



Radio Blackouts - X-Ray Flares:

There are currently five sunspot regions on the visible disc, but all of these are simple and benign, and present a low risk of significant flare activity. A number of bright flux regions, which correspond to returning sunspot regions, are due to rotate onto the visible disc from 07 June (day 2) with this reflected in a slightly increased risk of Moderate solar activity.

Otherwise solar activity is expected to be Low or Very Low solar activity.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is at background levels and is expected to remain at this level through the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) levels have been at mainly high levels but have shown a sharp drop in the last 6 hours, possibly due to a CME glancing the radiation belts. As the solar wind continues at background levels, electron counts are expected to oscillate between the moderate and high levels, but with a diminishing peak over the four day period.

Integrated electron fluence levels are expected to follow a steady downward trend through the next four days, reflecting the declining electron flux. This is indicated in the REFM forecast, but the reduction is likely to follow a shallower decline than modelled. This is however dependent on the potential CME effects.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	100	60	30	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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Figure 5: GOES-16 electron flux (top) and MOSWOC REFM model (below)

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